PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

То:				PCT	
see form PCT/ISA/220			WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43 <i>bis</i> .1)		
			Date of mailing (day/month/year) see	e form PCT/ISA/210 (second shee	et)
Applicant's or agent's file reference see form PCT/ISA/220	nce		FOR FURTHER A See paragraph 2 below		
		International filing date (d 16.12.2004	e (day/month/year) Priority date (day/month/year) 18.12.2003		
International Patent Classification G11C13/00	on (IPC) or b	ooth national classification a	and IPC		
Applicant MATSUSHITA ELECTRIC	C INDUST	FRIAL CO., LTD.			
Box No. I Basis Box No. II Prior Box No. III Non- Box No. IV Lack Box No. V Reas appli Box No. VI Certa Box No. VII Certa Box No. VIII Certa	s of the opinity rity -establishme of unity of soned state icability; cit ain docume ain defects ain observational prelinternational an Authorith nder Rule fed. ovided aboveritten reply of mailing our. e Form PC	nent of opinion with regalinvention ement under Rule 43 <i>bis</i> , ations and explanations ents cited in the international applations on the internation minary examination is maderally other than this one to 56.1 <i>bis</i> (b) that written open of Form PCT/ISA/220 or TAISA/220.	ard to novelty, inventive of the following such states of the supporting such such such such such such such such	e step and industrial applicable novelty, inventive step or industrial applicable movelty, inventive step or industrial step or industrial step or industrial step of the inventional searching authority. PEA, the applicant is invited that, before the expiration of the of 22 months from the priority.	ustrial a where nree
Name and mailing address of th	ne ISA:		Authorized Officer		wes Palago.

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WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No. PCT/JP2004/019291

_	Box No. I Basis of the opinion
1.	With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
•	This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2.	With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
	a. type of material:
	□ a sequence listing
	☐ table(s) related to the sequence listing
	b. format of material:
	☐ in written format
	☐ in computer readable form
	c. time of filing/furnishing:
	□ contained in the international application as filed.
	☐ filed together with the international application in computer readable form.
	☐ furnished subsequently to this Authority for the purposes of search.
3.	In addition, in the case that more than one version or copy of a sequence listing and/or table relating theret has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4.	Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No. PCT/JP2004/019291

	Box No. IV Lack of unity of	invention	
1.	☐ In response to the invitation	on (Form PCT/ISA/20	6) to pay additional fees, the applicant has:
	☐ paid additional fee	S.	
•	paid additional fee	s under protest.	
	not paid additional	fees.	
2.	☐ This Authority found that the applicant to pay addition	he requirement of un onal fees.	ity of invention is not complied with and chose not to invite
3.	This Authority considers that the	ne requirement of uni	ity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
	□ complied with		
	□ not complied with for the formula is a simple of the formula is	llowing reasons:	
	see separate sheet		
4.	Consequently, this report has	been established in r	respect of the following parts of the international application:
	☑ all parts.		
	$\hfill\Box$ the parts relating to claims	Nos.	
	☐ the parts relating to claims	Nos.	
	Box No. V Reasoned state	ment under Rule 43	Bbis.1(a)(i) with regard to novelty, inventive step or one supporting such statement
1.	Box No. V Reasoned state	ment under Rule 43	
1.	Box No. V Reasoned state industrial applicability; citat	ment under Rule 43	
1.	Box No. V Reasoned state industrial applicability; citat Statement	ement under Rule 43 ions and explanatio	ns supporting such statement
1.	Box No. V Reasoned state industrial applicability; citat Statement	ement under Rule 43 ions and explanatio Yes: Claims	9-11
1.	Box No. V Reasoned state industrial applicability; citated Statement Novelty (N)	ement under Rule 43 ions and explanation Yes: Claims No: Claims	9-11 1-8
1.	Box No. V Reasoned state industrial applicability; citated Statement Novelty (N)	ement under Rule 43 ions and explanatio Yes: Claims No: Claims Yes: Claims	9-11 1-8 10
	Box No. V Reasoned state industrial applicability; citated Statement Novelty (N) Inventive step (IS)	Yes: Claims No: Claims No: Claims No: Claims Yes: Claims Yes: Claims No: Claims	9-11 1-8 10 9,11
	Box No. V Reasoned state industrial applicability; citated Statement Novelty (N) Inventive step (IS) Industrial applicability (IA)	Yes: Claims No: Claims No: Claims No: Claims Yes: Claims Yes: Claims No: Claims	9-11 1-8 10 9,11
	Box No. V Reasoned state industrial applicability; citated Statement Novelty (N) Inventive step (IS) Industrial applicability (IA) Citations and explanations see separate sheet	Yes: Claims No: Claims Yes: Claims Claims No: Claims	9-11 1-8 10 9,11

claims are fully supported by the description, are made:

see separate sheet

Reference is made to the following documents:

D1: US-6-204-139 D2: US-6-473-332

D3: "Electric-pulse-induced reversible resistance change effect in magnetoresistive films", Liu S Q; Wu N J; Ignatiev A, APPLIED PHYSICS LETTERS, AMERICAN INSTITUTE OF PHYSICS, NEW YORK, US XP012025238

D4: US-2003-0003674

Re Item IV

Lack of unity of invention

Independent claims 1 and 9 relate to a method of initializing a variable-resistance. Independent claim 5 relates to a variable-resistance connected to a fixed resistor used during read. The only common concept is the variable-resistance, which is known from the prior art. Hence, the Application does not relate to one single group of inventions linked by a single general inventive concept as required by Rule 13 PCT.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

For the further purposes of this report it will be assumed that the objections of paragraph **<u>Item</u> <u>VIII</u>** were overcome by appropriate amendment of the claims.

1.1 The subject-matter of <u>claim 1</u> is not new in the sense of Article 33(2) PCT. Document D1 discloses in its figure 4a or 4b a method for initializing a material (variable-resistance material Gd_{0.7}Ca_{0.3}BaCo₂O₅₊₅or PCMO film) whose resistance value increases/decreases according to the polarity of an applied electric pulse (the first resistance value in the graphs before the application of any electric pulse is not the high or low resistance value used to store information, and this first value is changed and initialized to a low or high resistance value with application of electric pulses), wherein an electric pulse having a first polarity (-12V or 51V) is applied at least once between first and second electrodes connected to the variable-resistance material such that the potential of the first electrode is higher than that of the second electrode.

- 1.2 D1 discloses further the features of claims 2, 3 and 4:
 - -that the first electric pulse is repeatedly applied between the first and second electrodes (see the first four electrical pulses at -12V of fig.4a) till the variation rate of the resistance value of the variable-resistance material becomes smaller than a predetermined value (for the last three electrical pulses the variation is smaller than 10 ohms),
 - -that an electric pulse having a second polarity (see the following seven electrical pulses at +12V of fig.4a) is applied at least once between first and second electrodes connected to the variable-resistance material such that the potential of the first electrode is lower than that of the second electrode (opposite polarity) (the initialization is done with the -12V and +12V because if only the -12V are applied, the resistance obtained is higher than the maximal resistance obtained normally afterwards and thus the material is not yet initialized to his normal values),
 - -that the second electric pulse is repeatedly applied between the first and second electrodes (see following seven electrical pulses at +12V of fig.4a) till the variation rate of the resistance value of the variable-resistance material becomes smaller than a predetermined value (for the last two electrical pulses at +12V the variation is smaller than 25 ohms).
- 1.3 For the sake of completeness, it is added that D2 discloses also the steps of method claim 1 since the variable-resistance material (110) whose resistance value increases/decreases according to the polarity of an applied electric pulse is put to an initial resistive state by applying a reset electric pulse (see col 4 lines 9-13). It has to be mentioned that, in fact, any first programing is an initialization. Hence, D3 in its figure 1 discloses the steps of claims 1 to 2. As it is obvious to proceed afterwards to an erase (programming with opposite polarity), the steps of claims 3 to 4 in view of D3 are not inventive.
- 2. 1 The subject-matter of <u>claim 5</u> is not new in the sense of Article 33(2) PCT. Document D2 discloses in its fig.2, 5, 6 and 7 a memory device ((532) or (504), and (538)) formed using a material (variable-resistance material (208), PCMO or LSMO or GBCO) whose resistance value increases/decreases according to the polarity of an applied electric pulse, comprising:
 - -a variable-resistance material (208) to which first (212) and second (214) electrodes are

connected; and

-a fixed resistor (Rin (520)), one end of which is connected to the first or second electrode wherein an electric pulse is applied for recording between the first and second electrodes (see fig.6).

2.2 D2 discloses further that :

-memory information is read based on a voltage (VR) between the first and second electrodes which is obtained when a predetermined voltage (VS) is applied between one of the first and second electrodes which is not connected to the one end of the fixed resistor and the other end of the fixed resistor (see table of fig.7 with the values of VR), -memory information is read based on a voltage (potential of input node of differential amplifier (502)) between the ends of the fixed resistor which is obtained when a predetermined voltage (Vs) is applied between one of the first and second electrodes which is not connected to the one end of the fixed resistor and the other end of the fixed resistor (see fig.5),

-the variable-resistance material (208) is initialized in advance by the initialization method recited in any one of claims 1 to 4 (the first write initializing the variable-resistance).

Hence, the features of claims 6, 7 and 8 are known from D2.

3. D4 discloses in its figure 1 and 3 a memory circuit including first ((52) connected to W1 and B1) and second ((52) connected to W1 and B2) variable resistors connected in series between a first terminal (B1) and a second terminal (B2) wherein the first variable resistor being connected between the first terminal (B1) and a third terminal (W1) and having a resistance value which increases/decreases according to the polarity of a pulse voltage applied between the first terminal and the third terminal (see paragraph [0028]), and the second variable resistor being connected between the third terminal (W1) and the second terminal (B2) and having a resistance value which increases/decreases according to the polarity of a pulse voltage applied between the third terminal and the second terminal (see also paragraph [0028]).

D4 also discloses a block erase method wherein both cells are put at the same time to the same high or low resistance value (see paragraph [0025] and [0027]): hence D4 discloses the steps of applying a first pulse voltage having a first polarity between the first terminal and the third terminal at least once and applying a second pulse voltage

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having a second polarity between the third terminal and the second terminal at least once.

In D4 the two variable resistors are made of $Gd_{0.7}Ca_{0.3}BaCo_2O_{5+5}$ with bottom electrode made of YBCO or PCMO with bottom electrode made of platinum (see paragraphs [0014] and [0015]).

According to fig.4a or fig.4b of D1, when these variable resistors have not yet been subjected to application of a pulse voltage (electrical pulse number =0), they have an arbitrary initial resistance which corresponds neither to their high or low resistance state read afterwards during operation. D1 discloses that by applying a first pulse voltage and after an opposite pulse voltage, the variable resistors are initialized and afterwards achieve stable high or low resistance value.

Hence the person skilled in the art would be prompted to, in an initial state where the first and second resistors have not yet been subjected to application of a pulse voltage, perform a block erase, i.e apply a first pulse voltage having a first polarity between the first terminal and the third terminal at least once and applying a second pulse voltage having a second polarity between the third terminal and the second terminal at least once, and after this block erase, to apply a third pulse voltage having a polarity opposite to the pulse voltage applied just before to both variable resistors (at least one variable resistor would be programmed).

Hence, the steps of method <u>claims 9 and 11</u> are not inventive in view of D4 combined with the teaching of D1.

Re Item VIII

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Certain observations on the international application

- 1. In claim 1, 5, the bracketed expression "(variable-resistance material)" which does not contain a reference sign is unclear (Art. 6 PCT). First, the bracket render unclear whether the feature introduced is limiting or not. Second, the expression "variable-resistance material" could refer only to a material having just a variable resistance or to the specific materials disclosed by D2 (see page 1 of the description).
- 2. In claim 1, the expression "a method for initializing" is unclear (Art. 6 PCT). An initial state can be any state defined as origin. However, according to the description, it is clear

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (SEPARATE SHEET)

International application No.

PCT/JP2004/019291

that the first pulse voltage is applied in an initial state where the variable-resistance material have not yet been subjected to application of a pulse voltage.